KMAN PUBLISHING INSTITUTE
Journal Website

Article history:
Received 14 November 2023
Accepted 12 December 2023
Published online 20 December 2023

International Journal of Innovation Management and Organizational Behavior

Volume 3, Issue 5 (Special Issue on Finance and Economics), pp 60-67

IJIMOB International Journal of Innovation Management and Organizational Behavior

E-ISSN: 3041-8992

Applications of Artificial Intelligence in Auditing

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A r t i c l e I n f o

Article type:
Original Research

How to cite this article:
Mehabadi, M., & Shafiei, S. (2023). Applications of Artificial Intelligence in Auditing. *International Journal of Innovation Management and Organizational Behavior, 3*(5), 60-67.
https://doi.org/10.61838/kman.ijimob.3.5.8

A B S T R A C T

Objective: The purpose of this research is to examine the application of artificial intelligence in auditing.

Methodology: This study is applied in objective and descriptive-survey in terms of data collection, which was conducted with a qualitative approach. The population of this study consisted of experts and opinion leaders in the field of accounting and auditing, university professors and lecturers, and the board of directors of the national auditing organization, from which 24 individuals were selected using a purposive sampling method. Semi-structured interviews were utilized for data collection until theoretical saturation was achieved. For data analysis, systematic grounded theory and for analyses, three types of coding: open, axial, and selective, based on Strauss and Corbin's coding technique, were used.

Findings: The findings indicate that the model of artificial intelligence application in auditing includes causal conditions (human resources, financial resources, empowerment development, and competitiveness), contextual factors (accessibility, standardization, incentivization), strategies (strategy formulation and planning), and intervening conditions (management, cultural, infrastructure) outcomes (efficiency, accuracy, and speed).

Conclusion: Considering the research findings, it is necessary to develop the prerequisites of artificial intelligence in a process-oriented manner to create the context and motivation among auditors for the development of artificial intelligence applications in auditing in the country.

Keywords: *Artificial Intelligence, Auditing, Strategy, Infrastructure, Planning, Information Technology.*

1 Introduction

Over time, with the advent of information technology, significant changes have occurred across various fields. Artificial Intelligence (AI) is one of the technologies that is growing at an increasing rate and has been able to impact various business sectors (Gunz & Thorne, 2020). AI can be considered the most transformative technology of the current century, possessing vast and unlimited potential and has made an impact across various domains (Kellogg et al., 2019). Artificial Intelligence is a growing field of study that emerged in the mid-20th century. This technology primarily

uses computer systems to mimic human cognitive processes. While AI is mainly associated with computer science, it encompasses a wider range and includes disciplines such as linguistics, psychology, medicine, mathematics, accounting, and auditing (Boza & Evgeniou, 2021).

The advancement and application of artificial intelligence technology are transforming conventional life and work patterns, thereby creating irreversible changes in the social environment. To better adapt to the current society, where information is rapidly evolving, all disciplines and professions are restructuring or improving their strategies, organizations, products, and procedures. The auditing field is no exception and can now utilize electronic accounting, data mining, and multidimensional data analysis (Silvola & Vinnari, 2021). As the world transitions from the information age to the age of artificial intelligence, the auditing sector is on the verge of profound transformation. AI technologies are rapidly advancing and have the potential to revolutionize various aspects of accounting and auditing, promising to increase the speed and accuracy of auditors' performances (Gunz & Thorne, 2020). Auditing technology and methods are merely a subsection that AI is changing. This could have a significant impact on auditing objectives, especially auditors' objectives when applying financial statements and auditing methods (Manetti et al., 2021).

With the expansion and increase in information production and the need for rapid response to the fluid market demands, it is necessary to use capable tools that can examine, analyze, predict, and then make decisions instead of humans (Holt & Loraas, 2021). Organizations and financial service institutions are increasingly using AI to collect and transform data from various sources and extract information for better decision-making in complex environments to gain economic benefits (Jarrahi, 2018). AI can be seen as the umbrella in this global mega-trend, including big data approaches and complex machine learning algorithms for future prediction (Lindebaum et al., 2019).

Artificial intelligence is the activity of creating abilities in machines, such as computers, to display intelligent behavior observed in humans. AI represents the most advanced application of computers to date, attempting to mimic certain types of human logic (Bellucci et al., 2022). Despite all attention, humans consider AI a completely new concept. In the field of financial management and investment, after the widespread use of computers and software packages, a much deeper transformation occurred, which is the application of AI in analyzing companies' financial statuses and making financial decisions. Systems resulting from the use of AI have undoubtedly created a massive transformation in the financial services industry (Han et al., 2023).

Auditing is almost the first area of business where information and communication technology tools and methods have been applied. Auditing consists of a dense set of information about activities like collecting, organizing, processing, and evaluating data to provide a reliable opinion (audit opinion) about accounts. This final audit opinion usually combines audit judgments (based on relevant, appropriate, sufficient, and persuasive audit evidence) in various areas of financial reports (Losbichler & Lehner, 2021).

Information and communication technology tools are typically used in a wide range of tasks from simple mathematical calculations to complex tasks like statistical analysis and charting (Glikson & Woolley, 2020). These tools include a set of audit programs (consisting of standard software packages and specific software), inventory lists, Logit models, audit query programs (with full data analysis and examination capabilities), integrated audit monitoring components (planned methods that constantly examine real data and work conditions), expert systems, and internal control models typically used to identify the strengths and weaknesses of a system (Sun, 2019). Due to continuous advancements in computer technology, many large auditing firms have considered using AI in audit judgments as part of their integrated audit automation systems. Information and communication technology provisions like electronic data interchange, electronic file transfer, and image processing are gradually replacing traditional auditing methods, thereby completely changing the entire audit process (Albu & Flyverbom, 2019). In the field of auditing, although more fuzzy research has been done compared to financial accounting, due to the auditing characteristic based on sampling and human judgment, various dimensions of ambiguity exist (Seethamraju & Hecimovic, 2023). However, fuzzy research conducted in this field is also scarce. In auditing, despite the wide aspects of ambiguity and uncertainty, in cases such as audit planning, internal control evaluation, sample size determination, selected samples, evidence evaluation, audit risk, and the manner of audit reporting, not much fuzzy research has been conducted (Munoko et al., 2020). Since decision support systems based on information and communication technology continue to be of interest in the modern business world, alongside the increased pressure on auditors to play a more effective role

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E-ISSN: 3041-8992

in controlling and monitoring companies, this research examines the application of artificial intelligence in the auditing field.

2 Methods and Materials

2.1 Study Design and Participants

The present study is applied in objective and descriptive-survey in terms of its execution method, conducted with a qualitative approach. The grounded theory method based on Strauss and Corbin (1990) was employed for model development in this research. Grounded theory begins with a question and data collection can be conducted through various methods such as interviews, observation, and document review, continuing until the researcher is confident that further research does not add new information to the findings. Therefore, data collection is continued to the point of theoretical saturation, indicated by the recurrence of redundant and non-contributory information in the data collection process.

The population of the present study consisted of experts and opinion leaders in the field of accounting and auditing, university professors and lecturers, and the board of directors of the national auditing organization. In this study, sampling continued until sufficiency and theoretical saturation were achieved, and after conducting 24 interviews over a seven-month period, data analysis showed that no new data were added to the previous data. In other words, a significant percentage of the data extracted from the last interviews were repetitive. Therefore, after conducting 25 interviews and reaching theoretical saturation, the interviews were concluded.

2.2 Data Collection

Given the nature of the research, data collection was conducted in two ways:

Library Studies: These studies were conducted through the consultation of documents and records and internet searches to understand the literature and background related to the concepts of auditing and artificial intelligence.

Conducting Semi-Structured In-depth Interviews: To conduct the interviews, general research questions on three main topics including causal conditions, contextual and intervening factors, strategies for using artificial intelligence in auditing, and its outcomes were raised. Depending on the interviewee's time and interest in the topic, interviews lasted up to 60 minutes. To ensure the results of the interviews, the extracted information was sent to the interviewees for confirmation.

2.3 Data Analysis

In this research, the data analysis process was conducted using Strauss and Corbin's method and the MAXQDA software. Data analysis was carried out in three coding stages based on grounded theory, including open, axial, and selective coding. In the first stage, open coding, each concept identified in the interviews was labeled and raw open codes were generated based on the characteristics and dimensions of each concept. Then, in the axial coding stage, conceptually and characteristically related codes were collected and organized around a central axis. This stage was conducted for the organization and categorization of codes around the main themes. In the selective coding stage, by selecting important concepts and topics, the pursuit of extracting the main theme of the research was followed. The goal of this stage was the integration and refinement of data, leading to the emergence of the main category and theory.

In the present study, to ensure reliability and validity, the concept of research trustworthiness proposed by Lincoln and Guba (1985) was employed. They introduced credibility, transferability, dependability, and confirmability as alternatives to the classic criteria of reliability and validity.

In this research, validity and reliability were gathered through prolonged engagement in the research environment and discussions with professors and experts regarding the collected interviews. Review and re-examination of raw data and referring to them after reviewing the results for assessing interpretations were conducted. Transferability was also achieved in this research, and the context and conditions of the study were fully described, including the geographical scope of the study and the participants and their number. Regarding dependability, interviews were recorded and notes were taken at the time of the interview, and the categories obtained from open coding were logically related to each other. Additionally, the research's confirmability was examined by matching the obtained data with existing sources and consulting with participants and experts.

3 Findings and Results

Data coding in this study was performed using Spiegel's method (1994), which involves breaking down the data into conceptual units. Initially, interviews are transcribed, followed by line-by-line textual analysis. At this stage, the focus is on identifying and extracting primary concepts from

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E-ISSN: 3041-8992

the interview content. Thus, after each interview, the researcher extracts and codes the concepts present through repeated text analysis. A total of 24 interviews were conducted, resulting in 59 extracted concepts (Table 1). It is noted that codes related to concepts consist of a Latin letter and a number, where the Latin letter represents the interviewee and the number indicates the concept extracted from that particular interview. This process unveils the following concepts:

a) Causal conditions: Factors influencing the evolution and advancement of the main phenomenon. These factors are generally expressed in the data using terms like "when, while, since, because, due to." Even in the absence of these indicators, the researcher can identify influencing factors by closely analyzing the data and reviewing events that occurred before the main phenomenon.

b) Central phenomenon: The core phenomenon under investigation, the focal idea or concept, event, or occurrence that directs actions and reactions for management, control, or response. The central category forms the foundation and focus of the process. This category is the name (or conceptual name) considered as the construct or scheme. The category chosen as the central one should be abstract enough to connect other parent axes.

c) Contextual conditions: The setting or context, specific characteristics related to the phenomenon of interest. In other words, the environment where events related to the phenomenon occur. The context represents the set of specific conditions where strategies and reactions take place.

d) Strategies: Designed based on actions and reactions to control, manage, and address the phenomenon of interest. Strategies are purposeful and executed for a specific reason, always within the confines of intervening conditions that facilitate or limit them.

e) Intervening conditions: Structural factors belonging to a phenomenon and affecting strategies, actions, and reactions. These factors either facilitate or constrain strategies in a particular context.

f) Consequences: Outcomes resulting from the implementation of strategies, presented as the results and effects of actions and reactions. Predicting consequences is not always possible, and they may not align with individual expectations. Consequences can include negative events occurring now or in the future, and what is considered a consequence at one time may be viewed as conditions and factors at another.

Table 1

Application of Artificial Intelligence in Auditing: Identified Concepts

Main Category	Subcategory	Concepts
Causal Conditions	Human Resources	Utilization of specialized and efficient human resources
		Selection of managers specialized in artificial intelligence
		Empowerment in using artificial intelligence
		Recruitment and hiring of IT experts
		Benefit from experienced specialists and consultants
	Financial Resources	Attracting investors to implement and execute artificial intelligence programs
		Increased financial power through the expansion of artificial intelligence
		Pressure to reduce costs and increasing competition in the auditing industry
	Competitiveness	Discovering and exploiting resources and opportunities
		Creating a greater competitive advantage in services and products
		Standardization of services and products
		Competition with other market competitors
	Empowerment	Auditors need more precise tools for their duties
		Identifying the strengths of artificial intelligence in auditing
		Expanding the potential for increased automation
		Increase in larger and more complex data sets than before
Contextual Conditions	Accessibility	Increased volume of data available to auditing firms
		Auditing clients seeking faster, more accurate services
		Activities of auditing associations in the field of artificial intelligence
		Increased risk-taking by auditing firms
	Standardization	The necessity of standardizing auditing services and products
		Expansion of IT infrastructures in various fields
		Increased awareness and knowledge of auditors about artificial intelligence
	Incentivization	High cost of artificial intelligence for small auditing firms

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E-ISSN: 3041-8992

		Government support for the use of artificial intelligence
		Implementation of incentives by organizations to use artificial intelligence
		Development of companies supporting new technologies
Strategies	Planning	Setting goals and expectations from the use of artificial intelligence in auditing
		Selection of various artificial intelligence tools for use in auditing
		Training auditors to use artificial intelligence tools
		Planning and risk management for potential risks
	Strategy Formulation	Identifying organizational strengths and weaknesses for program implementation
		Continuous monitoring and evaluation of program execution
		Creation of an artificial intelligence specialization center
		Collaboration with companies specializing in artificial intelligence
		Participation in research and studies related to artificial intelligence in auditing
Intervening Factors	Management	Inappropriate use of the system and incorrect decision-making
		Lack of clear strategies for implementing artificial intelligence
		Long-term decision-making processes in program execution
	Cultural	Concerns about information security
		Risk of tools being transferred to competitors
		Prevention of the spread of specialized skills by competitors
		Artificial intelligence may raise ethical issues and privacy concerns
		Resistance from some auditors to use artificial intelligence
	Infrastructure	Significant infrastructure costs
		The need for continuous system updates and maintenance
		Lack of skills and knowledge to use artificial intelligence
Outcomes	Efficiency	Cost reduction due to automation of tasks and increased accuracy
		Creation of structural stability for auditing activities
		Detection of fraud or suspicious transactions
		Increase in structural stability of auditing activities
	Speed	Decision-making in a shorter time
		Reduction in risk assessment and predictive analysis time
		Improved decision-making and communications
		Increased demand for artificial intelligence experts
	Accuracy	Identification of anomalies and patterns in large data sets
		Increased accuracy and quality of auditing processes
		Transparency of the auditing process
		Change in business models of auditing firms

Selective coding leverages the outcomes of previous coding stages, selects the main category, systematically links other categories, confirms connections, and highlights categories needing further refinement. In this research, considering the objective, the application of artificial intelligence in auditing is chosen as the central phenomenon, and all other categories are assumed to relate to this central phenomenon. After identifying the main categories and determining the central phenomenon in the selective coding stage, the grounded theory is presented using the main categories. However, it's crucial to note that the data in the axial coding table indicate that each main category comprises several concepts, and implementing and executing the model for value creation in Iranian Premier League football clubs in reality depends on considering these concepts and final codes. Accordingly, both the paradigmatic model and the desired pattern are designed based on the extracted concepts to demonstrate the model.

In the paradigm model of artificial intelligence applications in auditing, strategies are adjusted to achieve an appropriate response given the causal conditions, interventions, and relevant contexts. Consequently, after implementing strategies, the outcomes, seen as the results and effects of these actions, are considered the output of the strategies. Strauss and Corbin's theoretical comparison tool is recommended to enhance the classification process of concepts into themes. Identified themes in the initial stages of analysis shape the researcher's thoughts, opinions, and beliefs. Topics and interviews are discussed.

From the interviews and data analysis, the researcher gained a better understanding of the interviewee's experience. There's a dynamic exchange between the themes and characteristics identified in the early coding stages. New ideas were identified in new interviews and added to the identified topics until the topics reached maximum theoretical variation. If necessary, some topics were renamed, and connections between different topics and

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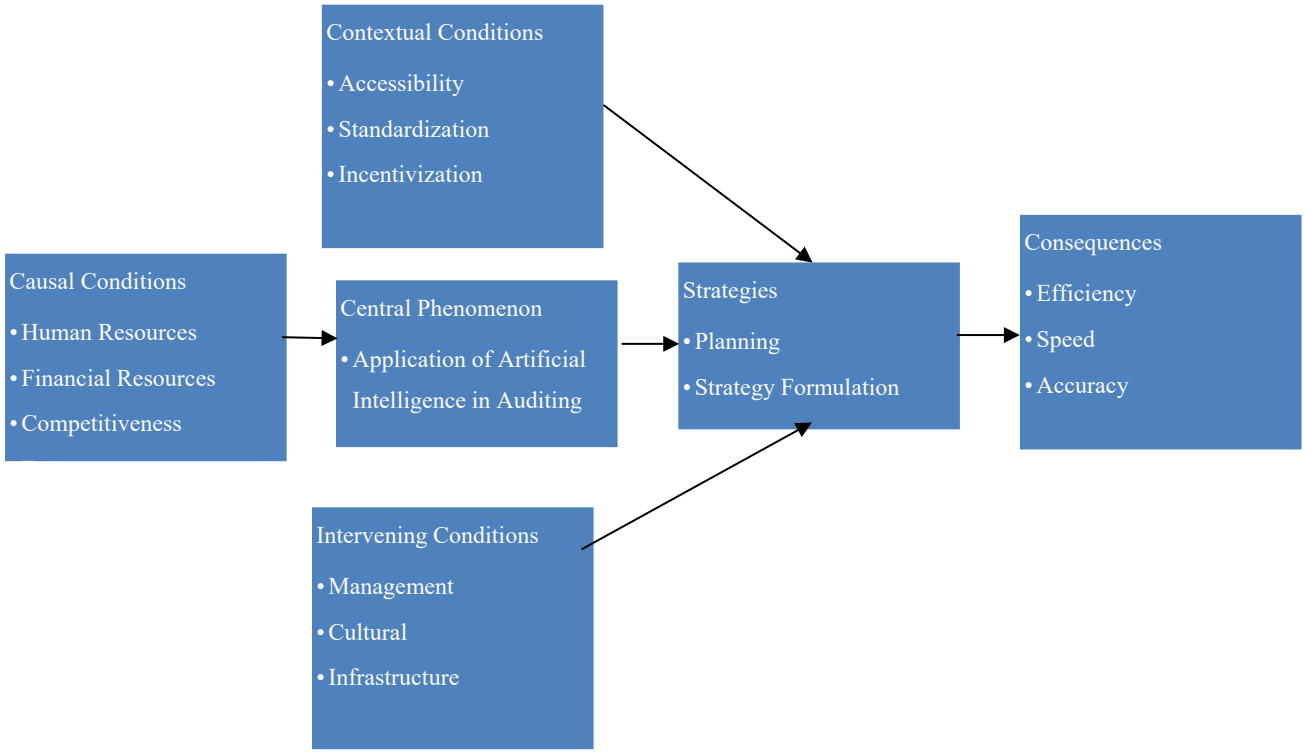
E-ISSN: 3041-8992

subtopics were formed. In open and axial coding, the paradigmatic model was expanded to include causal conditions, the central phenomenon, contextual conditions, intervening conditions, strategies, and outcomes.

As observed in Figure 1, the theoretical model is visible with the scale of the paradigmatic model. Given that interview questions with experts were formulated based on the paradigmatic model, interviewees provided their insights on the model's constitutive features, particularly based on the 5 dimensions of the model. However, analyses and iterations led to revisions in the initial responses of these individuals. After developing the paradigmatic model, to increase its validity, the final model was reviewed by experts familiar with artificial intelligence and auditing and the grounded theory methodology. These experts were asked to provide their feedback on the process of developing the final model, most of whom validated the pattern, while others offered constructive comments. Following analyses and iterations, necessary adjustments were made, and their final opinions were obtained.

Figure 1

Final Model of The Study



4 Discussion and Conclusion

Given that information and communication technology-based decision support systems are still of interest in the modern business world amidst the increased pressure on auditors to play a more effective role in controlling and supervising companies, continuing auditing as it currently stands diminishes the true value of the profession and poses a serious risk. This research has investigated the application areas of artificial intelligence in auditing activities. The results indicated that the use of artificial intelligence in auditing leads to an increase in the accuracy and quality of auditing activities and processes, improving their efficiency and productivity from the auditors' perspective.

Based on the outcomes, it is concluded that today, the most valuable businesses globally are internet and platform-based, with artificial intelligence being an example of technology playing a significant role in accounting and auditing. Consequently, this technology can provide shared, verified, and agreed-upon auditable data, and auditing can enhance audit effectiveness with AI tools using blockchain-verifiable and auditable data, which could revolutionize the accounting world.

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E-ISSN: 3041-8992

Moreover, among the areas where artificial intelligence is applied, based on the research findings, priority can be given to auditing activities that lead to increased accuracy and quality of auditing processes, such as the use of artificial intelligence in improving the process of evaluating internal controls or eliminating the effect of personal human judgments, activities that increase the structural stability of auditing activities such as measuring and managing audit risk and evaluating significance in auditing, and activities that result in increased efficiency and productivity in auditing like reducing ambiguity in the auditing environment, fraud detection in financial statements, and bankruptcy prediction. Auditors have also mentioned benefits of employing artificial intelligence in auditing, including, in order of importance, improved audit quality, created structural stability for auditing activities, increased efficiency and productivity, quicker decision-making, enhanced decision-making and communications, advanced training for staff, and skill development for newcomers.

Artificial intelligence is recognized for its benefits in time-saving, cost reduction, and productivity increase. This method shortens the necessary time to conduct sufficient auditing engagement with the concerned entity and reduces auditing costs, thereby increasing the net profit of the auditing firm while maintaining a high level of objectivity and accuracy of auditing results. Auditors can now focus on other significant issues. Artificial intelligence is a primary factor in an organization's competitiveness and sustainability. Another example of AI use in performing auditing engagements and achieving preliminary findings is identifying irregularities in accounting records, such as significant gaps, extremes, or very similar amounts. AI-based technology can thoroughly analyze accounting records like invoices and the like. For instance, for invoices, AI-based technology can quickly generate specific elements in a special report, such as issue date, receipt date, registration date, total amount, special terms, prepayments, penalties, etc. In some cases, if possible, such tools can compare the information obtained from invoices with previously determined specific criteria, which may include amounts in the appropriate account in the ledger and determine specific and objective preliminary results with a high level of reliability based on them. This method of providing necessary information and preliminary results shortens the necessary time for adequate auditing engagement with the concerned entity and reduces auditing costs. Auditors can now focus on other significant topics and allocate sufficient time to appropriately opine on whether financial statements contain significant distortions.

Based on the obtained results, the following suggestions are offered for the development of artificial intelligence in auditing:

Providing appropriate infrastructures such as hardware, software, and networks.

Support and commitment from senior management of the auditing firm for the use of artificial intelligence.

Enhancing organizational culture to welcome innovation and risk-taking.

Developing the knowledge and expertise of auditors for the use of artificial intelligence tools.

Authors' Contributions

All authors have contributed significantly to the research process and the development of the manuscript.

Declaration

In order to correct and improve the academic writing of our paper, we have used the language model ChatGPT.

Transparency Statement

Data are available for research purposes upon reasonable request to the corresponding author.

Acknowledgments

We would like to express our gratitude to all individuals helped us to do the project.

Declaration of Interest

The authors report no conflict of interest.

Funding

According to the authors, this article has no financial support.

Ethical Considerations

In this research, ethical standards including obtaining informed consent, ensuring privacy and confidentiality were observed.

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